Signal and signal-to-noise ratio of fluorescence spectroscopy

Input Data			Calculated Outputs	
Light source			Light source	
Blackbody temperature (Tc)	5300	C	Blackbody temperature (Tk)	=Tc+273
Emissivity (emisiv)	0.06		Total radiance (B)	=emisiv*0.0000000000018047*Tk^4
Flicker (fluctuation) noise fraction	0.01		Spectral radiance at exw (Blambda)	=emisiv*1.19E+016*exw^-5/(EXP(14380000/(exw*Tk))-1)
			Peak wavelength	=2897000/Tk
			Energy of photon at exw	=6.6261E-034*30000000000*10000000/exw
Excitation Monochromator			Excitation Monochromator	
Excitation wavelength (exw)	350	nm	Slit area (SlitAex)	=Hex*Wex/100
Slit height (Hex)	5	mm	Radiant power input (PhiInEx)	=B*SlitAex*sax
Slit width (Wex)	2	mm	Spectral bandpass (SBex)	=RLDex*Wex
Transmission factor of monochromator optics (Tex)	0.5		Radiant power output (PhiOutEx)	=Blambda*Tex*SBex*sax*SlitAex
Solid angle (Sax)	0.024	sr		
Reciprocal linear dispersion (RLDex)	3	nm/ mm		
Analytical Sample				
Molar absorptivity of analyte (a)	5600	liters/ mole-cm	Absorbance at excitation wavelength (Abs)	=a*l*c
Path length of cell (l)	1	cm	Fraction absorbed (F)	=1-10^-abs
Molar concentration of analyte (c)	1.00E-010	moles /liter	Radiant power absorbed (PhiAbs)	=PhiOutEx*F
Fluorescence quantum efficiency (q)	0.53		Fluorescence power emitted (PhiEm)	=PhiAbs*q
Spectral width of fluorescence emission (swf)	200	nm		

	Emission Monochromator			Emission Monochromator	
	Excitation wavelength (emw)	450	nm	Slit area (SlitAem)	=Hem*Wem/100
	Slit height (Hem)	5	mm	Radiant power input (PhiInEm)	=PhiEm*Sam/(4*PI())*SlitAem/(I*Hex)
	Slit width (Wem)	2	mm	Spectral bandpass (Sbem)	=RLDem*Wem
	Transmission factor of monochromator optics (Tem)	0.5		Radiant power output to detector (PhiOutEm)	=PhiInEm*Sbem/swf*Tem
	Solid angle (Sam)	0.024	sr	Spectral fraction measured	=Sbem/swf
	Reciprocal linear dispersion (RLDem)	3	nm/mm	Fraction of emission collected by monochromator solid angle	=Sam/(4*PI())
				Fraction of image area viewed	=SlitAem/(I*Hex)
	Detector (photomultiplier tube)				
				Energy of photon at emw	=6.6261E-034*30000000000*10000000/emw
				Cathode sensitivity (Rlam)	=Klam*1.6E-019/F36
	Secondary emission gain per stage (g)	4		Radiant power on photocathode (PhiDet)	=PhiOutEm
	Quantum efficiency of cathode (Klam)	0.2		photocathodic current (Ic)	=Rlam*PhiDet
	photomultiplier gain (m)	40000		photoanodic current (Ie)	=m*Rlam*PhiDet
	cathode thermionic emission rate (Rt)	200	Sec-1	Photon noise rms current (PhotNoise)	=SQRT(2*1.602E-019*m*(1+1/(g-1))*Ie*deltaf)
	Noise bandwidth (deltaf)	1	Sec-1	Themionic anode current (Iat)	=Rt*m*1.602E-019
				Thermionic noise rms current (ThermNoise)	=SQRT(2*1.602E-019*m*(1+1/(g-1))*Iat*deltaf)
				Flicker noise current (FlickerNoi	=Flicker*Ie
				Total rms noise	=SQRT(PhotNoise^2+ThermNoise^2+FlickerNoise^2)
				Signal-to-noise ratio (SNR)	=Ie/TotNoise

				Percent photon noise	=PhotNoise/(PhotNoise+ThermNoise+FlickerNoise)
				Percent thermal noise	=ThermNoise/(PhotNoise+ThermNoise+FlickerNoise)
				Percent flicker noise	=FlickerNoise/(PhotNoise+ThermNoise+FlickerNoise)

K				
W/sr/cm2				
W/sr/nm/cm2				
nm				
Joules				
cm2				
watts				
nm				
watts				
watts				
watts				

cm2				
watts				
nm				
watts				
Joules				
amp/watt				
watts				
amps				
amps				
amps				
amps				
amps				
amps				
